Meteorology 455/555  Group Problems - 1
Due 28 January 2005

1. Suppose \( v' = (10 \frac{m}{s}) \cos(\omega t) \cos(6\lambda) \)

(a) If \( q' = \left( 2 \frac{g}{kg} \right) \cos(6\lambda) \), what is \( [v'q'] \) if time averaging covers the period \( 0 \leq t \leq 2\pi/\omega \)?

(b) If instead, \( q' = \left( 2 \frac{g}{kg} \right) \cos(\omega t) \cos(6\lambda) \), what is \( [v'q'] \)?

2. (a) Suppose the 850 mb temperature field at 45 N is given by the function

\[
T_{850} = 278K + (10K) \cos(2\lambda) + (5K) \cos(4\lambda),
\]

where \( \lambda \) is longitude. What is \( [T] \)?

(b) Suppose that the 850 mb meridional wind field at 45 N is given by

\[
v_{850} = (10m/s) \cos(4\lambda)
\]

What is \( [vT] \)?

(c) What is \( [v^*T^*] \)? How is it related to \( [vT] \) in this problem? Why?

Some equations that might be useful:

\[
\int \cos(ax)dx = + \frac{1}{a} \sin(ax) \quad \int \cos^2(ax)dx = + \frac{1}{2} x + \frac{1}{4a} \sin(2ax)
\]

\[
\int \cos(ax) \cos(bx)dx = + \frac{\sin((a - b)x)}{2(a - b)} - \frac{\sin((a + b)x)}{2(a + b)}
\]

\[
\int \cos^3(ax)dx = + \frac{1}{3a} \sin(ax)(\cos^2(ax) + 2)
\]

\[
\sin\{n\pi\} = 0, \quad n = 0, \pm 1, \pm 2, \ldots
\]